Loosely Coupled Components

Demonstration of MPARE Functionality

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Environments

- Uncertain Missions
- Unanticipated Situations
- Increased Tempo
- Dynamic Changing Situation

Requirements

- Operate across heterogeneous networks
  - Data, resources, computation
- Analysis and models to convert data to information
- Platform Independent
- Inexpensive

- Reuse
- Flexible
- Extensible
- Continuous Replanning
- Collaboration across the network
- Automatic verification of plans
- Integration of systems
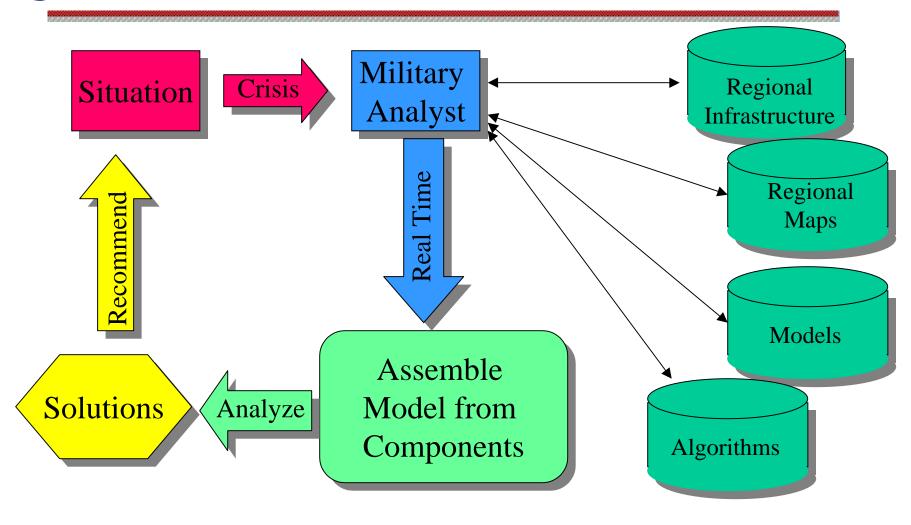
Advanced Information Technology

Network of Distributed Resources

- Data
- Databases
- Computation

- Models
- Algorithms
- People

Overview of Loosely-Coupled Planning System

Military Planning Project

- Architecture for map-based systems
- Platform independent
- Dynamic, extensible
- Real-time analysis
- Use models, not just displays
- Use component-based design

Special Operations Planning Tool
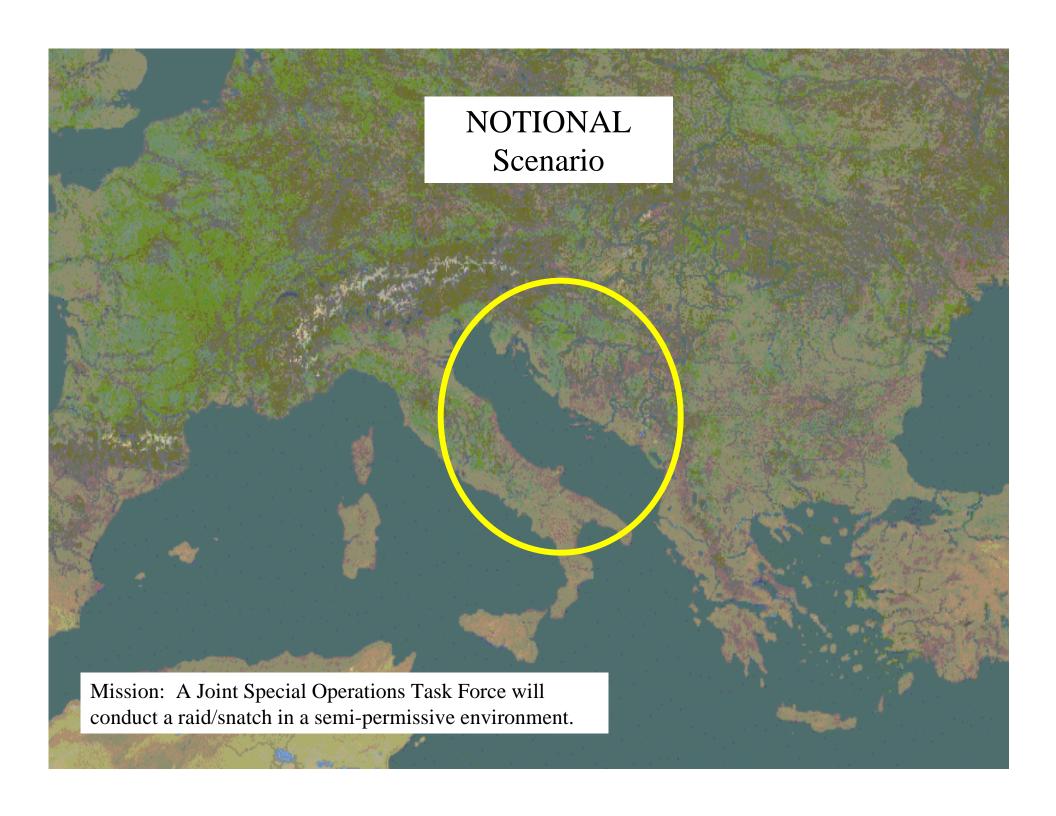
Background

- Diverse Assets
  - Joint Service
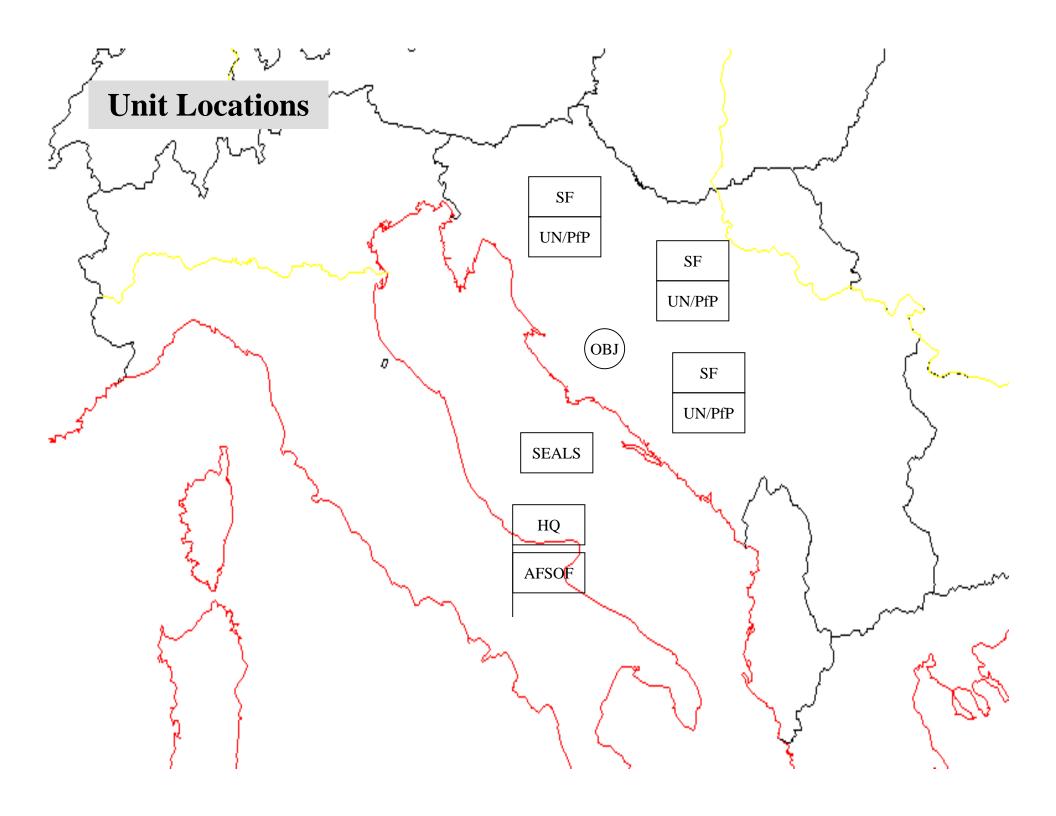 - Multi-nation
  - Inter-agency
  - Non-Government

- Distributed forces

- Unpredictable, time-sensitive crises
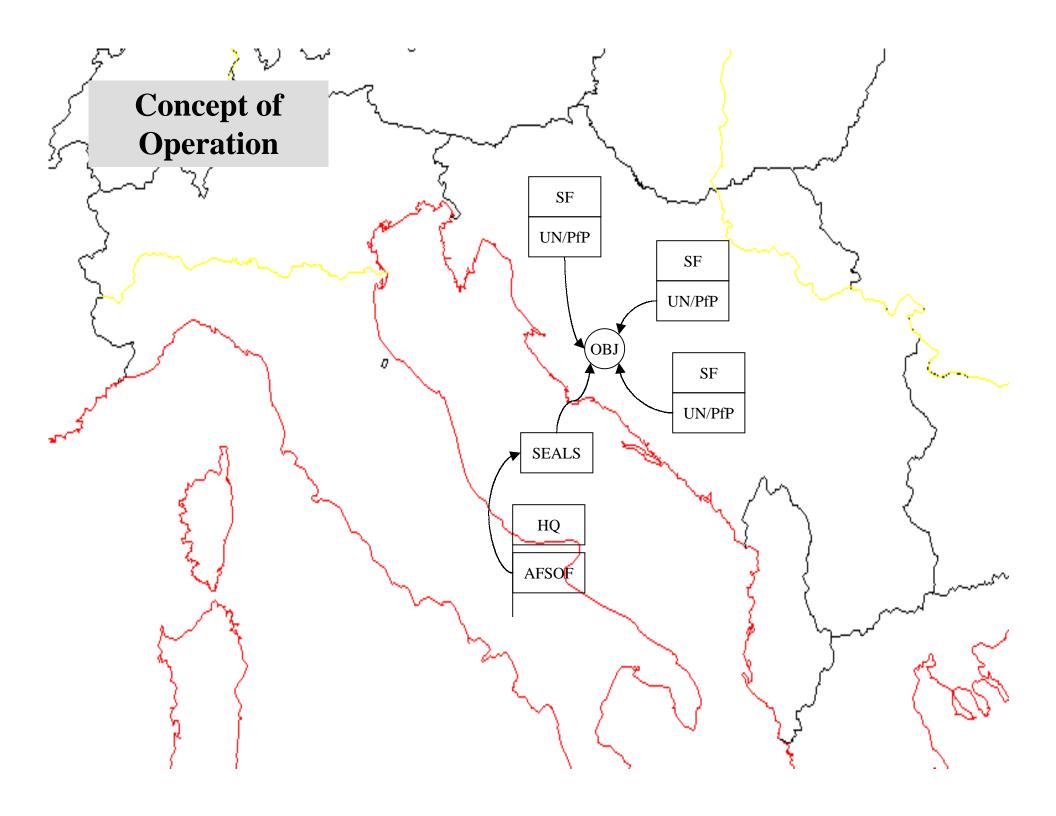
- Missions span the operations continuum
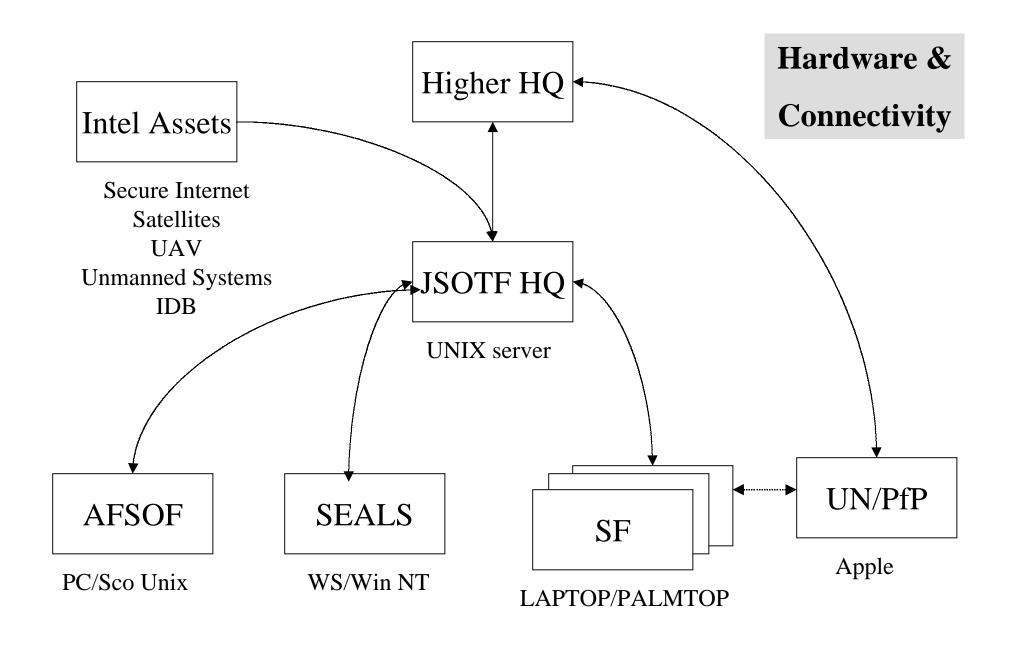
MPARE

- Mission Planning, Analysis, Rehearsal, and Execution

- Goal
  - Convert data to information (using models)
  - Incorporate Operations Research Tools

NOTIONAL
Scenario

Mission: A Joint Special Operations Task Force will conduct a raid/snatch in a semi-permissive environment.

Unit Locations

SF
UN/PfP

SF
UN/PfP

OBJ

SF
UN/PfP

SEALS

HQ

AFSOF

Concept of Operation

SF
UN/PfP

SF
UN/PfP

SF
UN/PfP

OBJ

SEALS

HQ
AFSOF

Hardware & Connectivity

Higher HQ

Intel Assets

Secure Internet
Satellites
UAV
Unmanned Systems
IDB

JSOTF HQ

UNIX server

AFSOF

PC/Sco Unix

SEALS

WS/Win NT

SF

LAPTOP/PALMTOP

UN/PfP

Apple

Demonstration of Prototype

- Deliberate Mission Planning
  - Visualization
  - Analysis
- Execution (Dynamic)
  - Unanticipated Excursion
- Adaptive Planning (Dynamic)
  - Visualization
  - Analysis

What Architecture has Achieved

- Access resources over network
- Map-based planning
  - image manipulation
- Thin client text editor
- Overlays
  - Graphs
  - Annotate overlays
- Graph models (multiple)
  - Integrate

- Parameterize algorithms
- Successive computations
- Platform independent
- Scalable
- Build algorithm list dynamically
- Algorithms independent of graph structure
- Reusable components

Residual Frameworks

- König ⟶ Graph and network algorithms
- Thistle ⟶ Georeference tools
- Simkit ⟶ Discrete event simulation
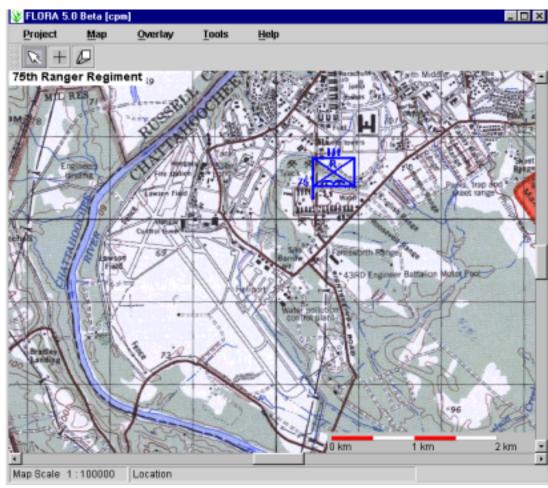- Modkit ⟶ Generic component modeling

Thistle

- **Map based Planning Tool**

- **Loosely Coupled**

Conclusion

- Constructed military planning tool for Special Operations Forces
- Validated an architecture that incorporates OR Models and algorithms into a real-time problem domain

SOMPASS

Special Operations Mission Planning and
Analysis Support System

Problem

- Current Mission Planning
  - Time and Labor Intensive
  - Manual Effort
  - Primitive Course of Action Analysis
  - Synchronization Difficult
  - Static Products
  - Planning Process Independent of Other Operational Phases

  Slow and Inflexible

Proposal

- Integrated/Dynamic Planning and Analysis
  - *MPARE* Ideology
  - Project Management Approach
  - Simplify Mission Development
  - Dynamic and Distributed
  - Integrated Analysis
  - Automatic Product Generation
    - Synchronization Matrix
    - Execution Checklist
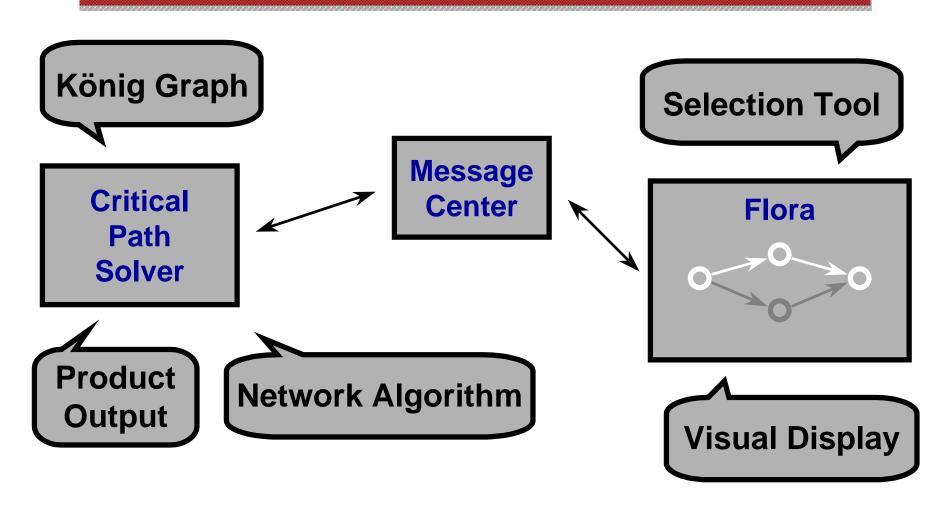 - Universal Application: All Operational Phases

Implementation

- ## OR Approach
  - Mission $\equiv$ Network Model, Tasks $\equiv$ Nodes
  - Graph Theory $\rightarrow$ Longest Path Problem
    - Critical Path Method (CPM), Activity-on-Node (AON)
  - Sensitivity Analysis
- ## Loosely Coupled Components
  - König Graph Package
    - Dynamic Properties
  - Flora Visual Display Package
    - Dynamic Display
  - Thistle Message Center Connectivity

Design

König Graph

Selection Tool

Critical Path Solver

Message Center

Flora

Product Output

Network Algorithm

Visual Display

SOF Tactical Intranet

LPD/LPI Communications for SOF
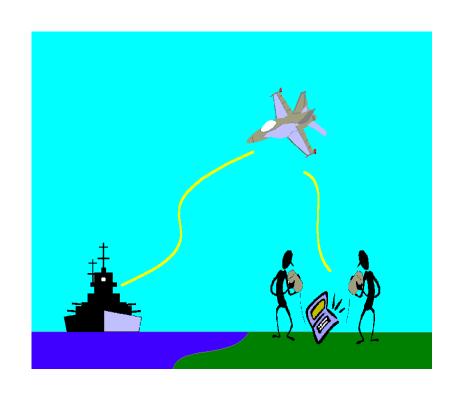using a COTS Wireless LAN

What is Needed

- High Bandwidth
- LPD/LPI
- Real time Comms
  - MPARE
  - Distributed Planning
  - Coordinated Execution
- Guardian Angel OPS

Why Go There?

- SCAMPI is not Portable!

- Bandwidth does matter

- Real time SR/BDA

- Real time OA assistance
  - LCC

- Real time deconfliction
  - GPS Tracking

- LPD/LPI matters

The System

- Lucent Technologies - WaveLAN
  - 1-2 Mbps throughput, automatic select
  - Direct Sequence Spread Spectrum format
  - Commercially Available

The System

- Lucent Technologies - WaveLAN
  - Low EMI output
  - Good Signal/Noise tolerance
  - Reliable throughput
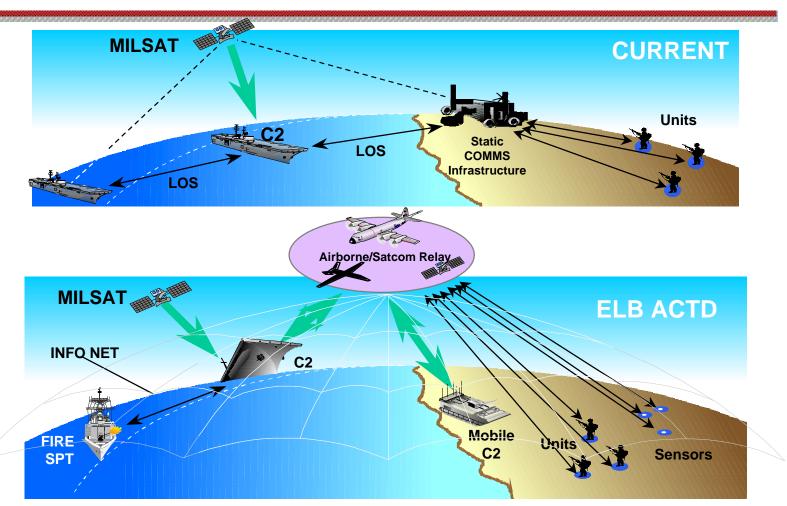 - TCP/IP or UDP
  - Low Power Option

Our Ground Station

- WavePoint II Access Point
  - Wireless to Ethernet conversion
  - Tested Antennas:
    - 14 dBi Yagi
    - 12.4 dBi Omni
    - 3 dBi mini-Omni
  - 1 watt amplifier
  - Easy to set up
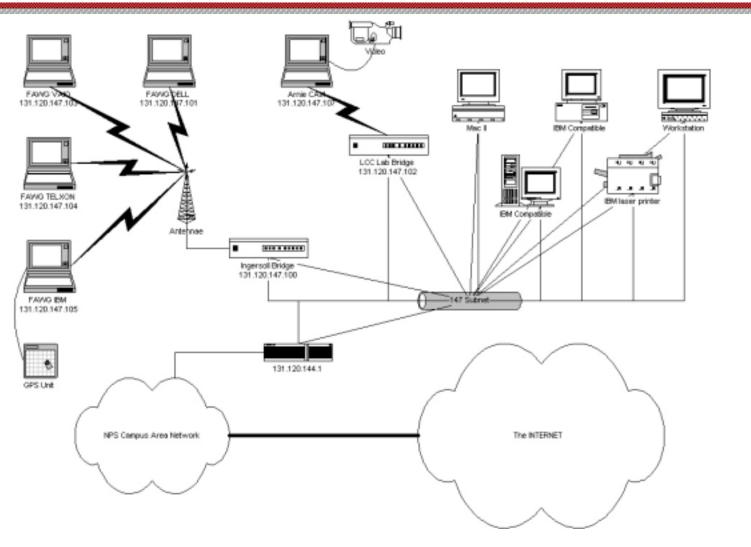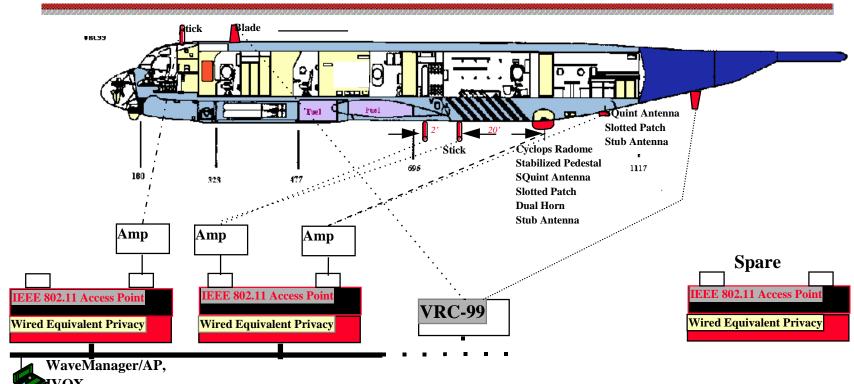 - Easy to move
  - < 5 pounds

Extending the Littoral Battlespace

The LCC Wireless Network

Airborne Relay Testbed

Stick   Blade

VRC99

Quint Antenna
Slotted Patch
Stub Antenna

2'   20'

Stick

Cyclops Radome
Stabilized Pedestal
SQuint Antenna
Slotted Patch
Dual Horn
Stub Antenna

180   323   477   695   1117

Amp   **Amp**   **Amp**

Spare

IEEE 802.11 Access Point

Wired Equivalent Privacy

IEEE 802.11 Access Point

Wired Equivalent Privacy

VRC-99

IEEE 802.11 Access Point

Wired Equivalent Privacy

WaveManager/AP,
IVOX

Our Airborne Testbed

- NPS Flying Club Cessna T-41B
  - Four Place aircraft
  - 60 - 120 Knots
  - up to 12,500 feet
  - 360° Visibility
  - CHEAP FLYING
    - $59 per hour wet

Remaining Issues

- Distance Expansion
  - Explore improvements in antenna and power output combinations

- Final Configuration
  - Reverse current setup:
    - AP airborne
    - Laptop GS

- WaveLAN III - 11 Mbps